



Delphi Research, Inc.

Catalytic Chemical Oxidation (Delphi Detox)

Technology Need:

Many Department of Energy (DOE) sites contain complex and variable mixtures of hazardous organics, inorganics, and radionuclides which are difficult to remediate effectively. Landfilling, incineration, and long-term storage techniques have been the traditional means of disposal of these wastes. Presently, new regulatory restrictions either prevent such techniques or make using them costly.

Technology Description:

Delphi has developed a catalytic wet oxidation process for the treatment of multi-component wastes, with the potential to destroy hazardous organic compounds while containing and concentrating metals from contaminated materials. This process is based on a patented combination (DETOXSM) of iron ions, a homogeneous oxidation catalyst, and a ferrous-iron to ferric-iron oxidation catalyst in an acid solution to oxidize organic compounds. Laboratory studies have been conducted to measure the destruction efficiency of DETOXSM applied to several model organic compounds, evaluate the fate of eleven model metals in the DETOXSM solution, and determine the ability of DETOXSM to remove organics and metals from soils. The data obtained in these tests were used in a preliminary engineering study for a prototype treatment system. Design parameters were established to guide design of a prototype DETOXSM unit for the treatment of hazardous organics and metals from wastes.

The process has the potential to oxidize virtually all organic compounds and make many metals soluble. It could be of considerable use where there are mixed organics and metals in soils and sludges, landfill materials, extraction output streams, obsolete or decommissioned parts, or other matrices. In waste management, the process can have a



variety of applications in treating Resource Conservation and Recovery Act (RCRA) wastes and in concentrating metals from waste streams for recovery.

Benefits:

<The chemical system is much more aggressive than most aqueous based processes and can treat more chemical compounds than wet oxidation at ambient conditions

<The oxidant is continuously generated in solution and the reduced species form of the oxidant is an OH⁻ ion or water

after neutralization in the acid solution; the heat input rate from oxidation of the organic materials is controlled by blending wastes to a fairly constant heating value

<The process appears to have potential application to leaching of organic and inorganic contaminants from inert matrix materials which will not dissolve in the working solution and are not oxidized by ferric ion

<Has been shown to destroy highly chlorinated compounds

<Oxidation of organic contaminants with destruction efficiencies exceeding 99.9999% for some organic materials

<Low treatment temperatures typically result in no production of NO_x, SO_x, dioxins, furans or volatile metals in the system off gasses

<Low emissions make off-gas treatment and permitting requirements less complex than requirements for thermal treatment

<The catalyst solution can accumulate toxic and/or radioactive metals until recovery or stabilization and disposal of metals is possible

Status and Accomplishments:

There have been multiple demonstration site changes for this technology including Weldon Springs, MO in 1994, RFETS, in 1996; and SRS, in 1998. A 25 kg per hour plant was designed, fabricated and installed at SRS's TNX facility. However, multiple issues led to discontinuation of the full scale demonstration.

A five gallon unit design was initiated and International Technology Corp was chosen as the support partner to host the demonstration at their research facility in Oak Ridge, TN. The unit was constructed and functional tests were performed between the fall of 2000 and May of 2001. Operational tests were conducted through June and July 2001. Data and operational data obtained in these tests were not consistent with laboratory data obtained in earlier tests in that foaming was encountered. The contract ended in August 2001.

In the fall of 2001 Delphi formed an association with a local University to address and resolve the outstanding technical issues required for successful commercialization of the DETOX® process. Specific issues being addressed are

<Identification of parameters which influence the formation of foam in DETOX®

<Evaluation of alternative reactor design criteria to improve oxidation rates and throughput of a DETOX® system.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 106
<http://ost.em.doe.gov/tms>

The National Energy Technology Laboratory Internet address is <http://www.netl.doe.gov>

For additional information, please visit the Delphi Research, Inc. website at <http://delphi-res.com/>